Securitization and Bank Performance

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ABSTRACT

Using predominantly pre-crisis US commercial bank data, this paper employs a propensity score matching approach to analyze whether individual banks did improve their performance through securitization. On average, our results show that securitizing banks tend to be more profitable institutions, with higher credit risk exposure. Despite a more diversified funding structure, they face higher funding costs. We also find that securitizing banks tend to hold larger and less diversified loan portfolios, have less liquidity, and hold less capital. However, our analysis does not provide evidence to suggest that securitization had an impact upon bank performance.

JEL codes: G21; G32

Keywords: securitization; bank performance; propensity score matching.

1 INTRODUCTION

Before the recent financial crisis proponents of securitization, which included the banks themselves, as well as investors, regulators, and governments, believed that this activity helped improve bank performance. In addition, it was generally perceived that securitization promoted a more efficient allocation of risk and a relaxation of constraints on credit availability, therefore providing social benefits in addition to private ones. We can now see that the securitization trend also led to an increase in systemic risk that crystallized with the collapse of Lehman Brothers. Since then, several studies have investigated the link between securitization and financial instability (BIS 2008, Shin 2009). This literature generally concludes that credit risk transfer techniques (CRT) undermine financial stability and emphasizes the misalignment of incentives between banks and investors in the securitization process.[1] A number of other recent papers provide evidence to suggest that securitization went hand in hand with a decline in credit standards, particularly in relation to the securitization of subprime mortgages (Mian and Sufi 2009, Keys et al. 2010, Elul 2011, Dell'Ariccia, Igan, and Laeven 2012).

Despite the weaknesses in the securitization process revealed by the crisis, policy-makers as well as market practitioners, acknowledge its potential benefits and are currently attempting to revive the market by increasing transparency and by introducing changes in terms of simplicity and standardization.[2] These new policies aim to ensure that securitization remains beneficial and that potential risks do not outweigh potential benefits, both at the individual bank level and for the market as a whole.

We contribute to the ongoing securitization debate by assessing whether individual banks had improved their performance through accessing the securitization market in the run up to the crisis. Economic theory tells us that, by using securitization, a bank may be able to improve its performance through a number of channels, including lower funding costs, improved credit risk management, and enhanced profitability.[3] While the

performance benefits from the originating bank's perspective can be substantial, in practice the key to their realization lies in the quality of the underlying assets, which in turn is directly related to the underwriting and credit risk management employed by the banks (FDIC 2007). As a result, the net impact of securitization remains ambiguous. It is therefore important that we establish at the individual bank level whether securitization enhances the performance of securitizing banks. To this end, in this paper we estimate the effects of securitization on a number of bank performance indicators, including: (i) cost of funding; (ii) credit risk; (iii) profitability; (iv) interest income and expense structure; (v) liquidity; (vi) loan portfolio; (vii) capital; and finally (viii) growth.

An important issue that arises when attempting to estimate the effect of securitization on bank performance is that the choice to securitize may be endogenous, that is, banks determine whether they want to access the securitization market and when. To address self-selection concerns with regard to the endogeneity of the decision to securitize, two common approaches have been used in the literature: instrumental variables (IV) and Heckman selection estimators. However, both approaches suffer from a number of issues. The IV method requires the existence of at least one instrumental variable that determines the treatment and is unrelated to unobserved heterogeneity; but the choice of this instrument might create potential issues. While the Heckman selection estimator is more robust than the instrumental variables estimator, it is more demanding on the assumptions about the structure of the model (Blundell and Dias 2000).

Our empirical design seeks to address self-selection concerns with regard to the endogeneity of the securitization decision by applying a propensity score matching approach. To our knowledge, this methodology has not been employed in this context in the past, and thus represents the key methodological contribution of our paper. Specifically, we estimate the securitization effect on the change in the performance of banks measured as the difference in outcomes before and after securitization. This is

known as a difference-in-differences or double-difference matching strategy, where the first difference removes the unobserved heterogeneity and restores conditional independence and the second difference produces the impact estimate.

Our univariate analysis of securitizing and non-securitizing US commercial banks between 2001 and 2008 shows that securitizing banks tend to be more profitable institutions, have higher credit risk exposure, and have a more diversified funding structure. We also find that they have higher funding costs and tend to hold larger and less diversified loan portfolios, are less liquid, and hold less capital. However, our propensity score matching analysis does not provide evidence to suggest that securitization had an impact upon bank performance. For non-securitizing banks that have similar ex-ante characteristics to first-time securitizers, we find instead that the use of alternative performance-enhancing techniques had a similar impact. Therefore, the results presented in this paper show that securitization did not, on average, improve the performance of individual banks compared to adequately matched non-securitizing banks. Rather our evidence suggests that securitization allowed banks to maintain risky and more profitable activities. Finally, our results seem to support previous evidence that in the run up to the crisis the risks associated with increasingly complex securitization structures outweighed the benefits.

The rest of this paper is organized as follows: Section 2 reviews the relevant literature; Section 3 discusses methodological issues in estimating the effect of securitization on bank performance and introduces the propensity score matching approach used in this paper; Section 4 presents the data and preliminary univariate analysis; Section 5 lays out the implementation of the propensity score matching; Section 6 presents the results of the propensity score matching analysis; and finally, Section 7 concludes the paper.

2 LITERATURE REVIEW

Securitization involves a bank transforming its (usually) illiquid assets, that are traditionally held until maturity, into marketable securities by pooling these assets and transferring them into a special purpose vehicle (SPV), a bankruptcy-remote entity that in turn finances the purchase through the issuance of securities backed by the pool. Between the early 1990s and 2008 there was a tremendous increase in the size of securitization markets. In the US, the outstanding volume of mortgage-backed securities increased from $2.3 trillion in 1994 to $8.4 trillion by the end of 2008, while the market for asset-backed securities increased from $192 billion to $2.6 trillion over the same period. In Europe, at year-end 2008, the outstanding volume of mortgage-backed securities reached about $2 trillion (from $26 billion in 1994), while the market for asset-backed securities reached $299 billion (from $5 billion in 1994).[4] According to the International Monetary Fund (IMF 2009), asset-backed securities and covered bonds provided between 20 per cent and 60 per cent of the funding for new residential mortgage loans originated in mature economies before the credit crisis of 2008. After this extended period of rapid expansion, securitization markets froze in late 2008 following the collapse of Lehman Brothers. The impact of the crisis on securitization markets has since been well documented (Brunnermeier 2009, Gorton 2010, BIS 2011).

With the rapid growth in the market for securitized assets, there existed a substantial academic literature that focused on both the possible benefits of securitization as well as the main drivers and effects of the process.[5] Below we briefly review this literature.

2.1 The Economic Benefits of Securitization

Early studies of securitization focused on its potential economic benefits. Greenbaum and Thakor (1987), Pavel and Phillis (1987), and Hess and Smith (1988) suggest that securitization provides a means of reducing risk, of diversifying portfolios, and of funding both ongoing operations and the purchase of new assets. Greenbaum and Thakor suggest that securitization allows banks to specialize in activities of comparative advantage while shifting the activities of comparative disadvantage. Rosenthal and Ocampo (1988) argue that securitization offers banks a way of lowering their cost of financing. Boot and Thakor (1993) show that, in the presence of asymmetric information, pooling assets and issuing multiple financial claims with different risk characteristics against the pool cash flow enables the issuer to increase its expected revenue. Empirical evidence consistent with the profitability-enhancing theory of securitization is found by Bannier and Hänsel (2008) and by Affinito and Tagliaferri (2010).

Flannery (1994), Lockwood, Rutherford, and Herrera (1996), and James (1988) consider the role of securitization in mitigating the underinvestment problem of financial intermediaries. Lockwood, Rutherford, and Herrera suggest that the cash inflow from the issuance of asset-backed securities can be used to retire existing debt, which in turn reduces interest expense and increases reported earnings. More recently, Chiesa (2008) suggests that optimal credit risk transfer (which can be achieved via securitization) reduces the amount of capital that a bank must stake in order for it to be incentive-compatible to screen and monitor its loans. As a consequence, Chiesa argues that securitization can enhance loan monitoring, leading to an increase in the volume of financial intermediation and an improvement in welfare.

2.2 The Determinants of Securitization

Another branch of the literature focuses on the economic motives that encourage banks to securitize. Theory provides us with three main determinants: (i) funding requirements; (ii) risk sharing; and (iii) profitability. One fourth theory puts forward the role of capital and the potential for regulatory arbitrage because securitization allows banks to adjust their regulatory capital ratios.

Donahoo and Shaffer (1991) suggest that deposit-taking institutions securitize to reduce reserve and capital requirements. But Jones (2000) argues that "regulatory capital arbitrage" is not the only incentive to engage in securitization and suggests that banks will also securitize to benefit from increased economies of scale, to reduce the costs of debt financing, and to diversify funding sources. Minton, Sanders, and Strahan (2004) and Calomiris and Mason (2004) provide empirical tests of the regulatory arbitrage hypothesis against the efficient contracting hypothesis, which suggests that securitization lowers the cost of debt finance. The evidence from both studies supports the efficient contracting view. In particular, Minton, Sanders, and Strahan find that unregulated finance companies and investment banks are more likely to securitize than commercial banks; in addition, risky and highly leveraged financial institutions are more likely to engage in securitization than safer ones. Bannier and Hänsel (2008) find consistent results using data on European banks' collateralized loan obligation transactions. The authors conclude that the securitization market seems to be driven by credit risk management and liquidity raising incentives, rather than by regulatory capital arbitrage. Recent work by Panetta and Pozzolo (2010) indicates that banks are more likely to securitize when they face lower direct and indirect costs. They also find evidence to suggest that banks securitize to modify their asset portfolio, allowing them to take up riskier profit opportunities. Using a sample of Italian bank data, Affinito and Tagliaferri (2010) analyze the ex-ante determinants of securitization and show that less capitalized, less liquid, and less

profitable banks with higher levels of non-performing loans are more likely to securitize, and in larger amounts.

2.3 The Effects of Securitization

Another strand of research has focused on the effects of securitization on the originating banks. Some studies have focused on the quality of assets securitized. Dionne and Harchaoui (2003) find evidence to suggest that regulation encouraged banks to hold more risky assets and to securitize their lower risk assets. Ambrose, LaCour-Little, and Sanders (2005) also found that in response to regulatory capital incentives lenders tended to retain riskier loans in their portfolios. However, Carey (1998) shows that the default rates on loans retained by the originator were lower than the default rates on the loans sold to other investors, which implies that banks tend to retain higher quality loans. Similarly, recent studies by Mian and Sufi (2009), Keys et al. (2010), and Dell'Ariccia, Igan, and Laeven (2012) find evidence to suggest that US banks securitized their worst mortgage loans over the last decade. Calem, Henderson, and Liles (2010) also confirm this view with findings of evidence of "cream-skimming" behavior during the subprime lending boom. Krainer and Laderman (2011) explore the factors that determine which loans are securitized. The results show that the loans chosen by lenders for private-label securitizations tend to be riskier than the loans retained in their own portfolios.

Other researchers have investigated the implicit recourse commonly provided by the originating bank and the resulting risk and performance implications for the issuer. Calomiris and Mason (2004) and Higgins and Mason (2004) argue that risk remains with the securitizing banks as a result of implicit recourse. Chen, Liu, and Ryan (2008) find that risk retention by banks varies by type of securitization and is relatively low in the case of mortgages, while relatively high for revolving loans such as credit card receivables.

Similarly, Vermilyea, Webb, and Kish (2008) find evidence of implicit recourse in credit card securitizations. In particular, they show that banks that securitize credit card receivables, and banks with poorly performing securitization portfolios, are more likely to claim fraud losses on securitized assets which are borne by the originator as opposed to credit losses incurred by the owner of the assets, that is, by the SPV. Higgins and Mason identify beneficial effects of recourse which arise in the form of increased short- and long-term stock returns and improved long-term performance. This evidence is consistent with that of Gorton and Souleles (2006), who find that market prices of asset-backed securities reflect the originator's ability to provide recourse. Barth, Ormazabal, and Taylor (2012) examine whether credit rating agencies and the bond market have a different view of the sources of credit risk. They find that while credit rating agencies view securitizations as asset sales, bond market participants view securitizations as secured borrowing.

Finally, some authors have focused on the reinvestment of securitization proceeds. Cebenoyan and Strahan (2004) find evidence to suggest that banks use the risk-reducing benefits of securitization to engage in more profitable but higher risk activities and to operate with greater financial leverage. Purnanandam (2011) also provides evidence to suggest that US banks used the proceeds from securitizations to issue loans with higher than average default risk. In particular, the author shows that US banks that used credit risk transfer techniques to a larger extent before the 2007 subprime crisis had significantly higher mortgage charge-offs after the crisis. On the other hand, Jiangli and Pritsker (2008) suggest a positive role for mortgage securitization and relate the recent turmoil in mortgage credit and securitization markets to recent excesses in those markets. Finally, Nadauld and Weisbach (2011) investigate whether securitization-driven demand for corporate bank loans had an impact on the cost of corporate debt. Their results indicate that yield on a loan that was subsequently securitized was 15 basis points lower, on average, than that on an otherwise identical loan that was not securitized, a result that

provides evidence to support the view that securitization led to a reduction in the cost of corporate debt.

Overall, the existing literature has focused on different aspects of the securitization process, but has not provided comprehensive evidence of the impact of securitization on bank performance. While in theory there may well be benefits of accessing the securitization market from the originating bank's perspective, the empirical evidence to date seems to suggest that it went hand in hand with a decline in credit standards. Evidence also suggests that banks used the proceeds from securitizations to engage in more profitable but higher risk activities and to operate with greater financial leverage. We therefore believe that it is important to establish whether securitization enhances the performance of securitizing banks at the individual bank level, otherwise in the rush to condemn the process of securitization we run the risk of throwing the baby out with the bath water. Using US commercial banking data for individual banks from 2001 to 2008, we contribute to the existing literature by evaluating the effects of securitization on several bank performance indicators, including cost of funding, credit risk, and profitability. In addition, the methodology that we apply in this paper augments the existing literature by addressing the self-selection concerns with regard to the endogeneity of the decision to securitize by applying a propensity score matching approach. We now turn to the empirical design of our research.

3 EMPIRICAL DESIGN

In this section, we first discuss the methodological issues in estimating securitization effects and then introduce the propensity score matching approach used in this paper to address those issues.

3.1 Methodological Issues in Estimating Securitization Effects

The analysis of the effect of securitization on bank performance gives rise to several methodological issues, particularly, self-selection concerns with regard to the endogeneity of the decision to securitize. First, comparing securitizing banks with non-securitizers might yield biased estimates of the securitization effect because the performance of non-securitizers may differ systematically from the performance of securitizers in the absence of securitization. Therefore, if securitizers are found to perform better, on average, than non-securitizers, the difference may be due to the effect of having accessed the securitization market or to differences in banks' characteristics prior to securitization. Second, considering only securitizing banks eliminates the possibility of a hypothetical benchmark, that is, the performance that banks would have had, had they not securitized. Furthermore, the observed change in performance might be due to shocks affecting all banks equally.[6]

In an attempt to identify the effect of securitization on bank performance, in this paper we focus on first-time securitizers. To understand our choice of analysis, consider the following three types of bank:

(i) “securitizers”, that is, banks that have undertaken at least one securitization transaction at the beginning of an observation period;

(ii) “non-securitizers”, that is, banks that do not engage in securitization throughout the observation period; and

(iii) “first-time securitizers”, that is, banks that switch from being non-securitizers to being securitizers during the observation period (at time *t*) by conducting their first securitization transaction.

Figure 1 illustrates the theoretical trajectories of average performances of the three types of bank and their relative positions. Recall that the proponents of securitization argue that, when used responsibly, it should allow banks to improve their performance through a

number of channels as discussed earlier. Therefore, securitizing banks are assumed to perform better than non-securitizing ones. This is reflected in Figure 1 by drawing the performance trajectory of securitizers above the performance trajectory of non-securitizers. However, as noted above, this could be because securitizers were better performers prior to securitization and/or the consequence of using the securitization market.

<Insert Figure 1 about here>

Looking at first-time securitizers might help to disentangle the securitization effect. Specifically, if securitization has a positive impact on bank performance, the latter should improve once these banks start to securitize. As shown in Figure 1, the performance trajectory of first-time securitizers should become steeper and closer to that of securitizers after time *t.*

To test this hypothesis, we need to know what would have happened to the performance of first-time securitizers had they not securitized. Because it is impossible to observe the same bank in both states, we need to find an appropriate proxy for the counterfactual performance of first-time securitizers. In other words, we need to find a proxy for the dotted lines in Figure 1.

Good candidates for the counterfactual are non-securitizing banks. The performance trajectory of the non-securitizers after time *t* could be considered a proxy for the dotted lines. However, this comparison would still entail a selection problem (Heckman and Smith 1995) - first-time securitizers might be *ex-ante* different from those that never access the securitization market. Specifically, these banks might be either better or worse performers at time *t-1* compared to non-securitizers, which is reflected by the trajectories “First-Time Securitizers A” and “First-Time Securitizers B”, accordingly.

To overcome this issue and to disentangle the securitization effect, the ex-post performance of first-time securitizers (at time *t+1*) should be compared with that of non-securitizers that are as similar as possible to the former before any securitization.

Therefore, we need to build a control group from the non-securitizers whose performance trajectory lies as close as possible to that of the first-time securitizers at time *t-1*. To construct this control group, we apply a propensity score matching approach.

3.2 The Propensity Score Matching (PSM) Approach

Matching has become a popular non-parametric approach for estimating causal effects and it is widely used in policy impact analysis. Although it is a relatively new technique in the finance literature, this method has been applied in the past to the question of diversification (Villalonga 2004), in the context of foreign investment (Barba Navaretti and Castellani 2008), and to the decision of firms to go public (Saunders and Steffen 2011). The idea and methodology can be applied in any study where it is possible to identify: (i) a treatment; (ii) a group of treated units; and (iii) a group of non-treated units (Caliendo and Kopeinig 2008). In this study we apply propensity score matching (PSM) to gauge the causal effect of securitization on bank performance, with the first securitization considered as the treatment, the first-time securitizers as the group of treated units, and the non-securitizers as the group of non-treated units.

To estimate the causal effect of securitization, we need to know what would have happened to the performance of securitizing banks had they not securitized. To do so, let S_{it} be a variable indicating securitization activity and taking a value equal to one if bank *i* conducts a securitization transaction for the first time in period *t*. Let Δy^{1}_{it+1} be the performance change of bank *i* at time *t+1* after having securitized assets in period *t* and let Δy^{0}_{it+1} be the hypothetical performance change of the same bank *i* at the same time *t+1* had it not securitized assets in period *t* (where $\Delta y_{it+1} = y_{it+1} - y_{it-1}$). The effect of

securitization on the performance of bank *i*, known in the evaluation literature as the average treatment effect on the treated, can be expressed as:

$$\tau = E(\Delta y^{1}_{it+1} \mid S_{it} = 1) - E(\Delta y^{0}_{it+1} \mid S_{it} = 1) \quad (1)$$

In equation (1), $E(\Delta y^{0}_{it+1} \mid S_{it} = 1)$, which represents the counterfactual mean or the hypothetical performance change of a first-time securitizer had it not securitized, is unobservable. This constitutes the fundamental problem of causal inference in evaluation studies (see Holland 1986). To overcome this problem, we need to find a proxy for this counterfactual mean. Using the mean outcome for non-securitizers, that is $E(\Delta y^{0}_{it+1} \mid S_{it} = 0)$ as a proxy for the counterfactual mean, equation (1) becomes:

$$\tau = E(\Delta y^{1}_{it+1} \mid S_{it} = 1) - E(\Delta y^{0}_{it+1} \mid S_{it} = 0) \quad (2)$$

Unless $E(\Delta y^{0}_{it+1} \mid S_{it} = 1) = E(\Delta y^{0}_{it+1} \mid S_{it} = 0)$, equation (2) is a biased estimator of equation (1) because it would yield estimates of the securitization effect plus selection bias (Heckman and Smith 1995). Here, the selection bias stems from the unit heterogeneity, or the fact that banks might choose endogenously whether to securitize and therefore first-time securitizers and non-securitizers might be systematically different prior to the securitization period *t* (that is, at time *t-1*).

In experimental studies, the selection problem is dealt with by random assignment of treatment, which ensures that every individual has the same ex-ante chance of receiving treatment (Ravallion 2003). In non-experimental studies, the selection problem is of paramount concern because there is no direct estimate of the counterfactual mean analogous to the one based on randomization (Dehejia and Wahba 2002, Smith and Todd 2005).

A variety of non-experimental estimators allow for the reduction and possible elimination of the selection bias in the estimation of average treatment effects under different assumptions. Two common approaches are the use of instrumental variables and Heckman selection estimators. However, both approaches suffer from a number of

issues.[7] In this paper we use a matching approach to deal with the selection bias. This is a non-parametric approach that enables us to identify the effect of the treatment on the outcome under unconfoundedness and common support assumptions (discussed later in this section). To apply this approach to the case of securitization, we build a control group from non-securitizers that are similar to the first-time securitizers in all relevant pre-securitization characteristics. Therefore, the causal effect of securitization could be presented as:

$$\tau = E(\Delta y^{1}_{it+1} \mid S_{it} = 1, X_{it-1}) - E(\Delta y^{0}_{it+1} \mid S_{it} = 0, X_{it-1}) \quad (3)$$

where $E(\Delta y^{1}_{it+1} \mid S_{it} = 1, X_{it-1})$ is the mean performance change of the first-time securitizers at time *t+1* after securitizing in period *t*; $E(\Delta y^{0}_{it+1} \mid S_{it} = 0, X_{it-1})$ is the weighted mean performance change of the control group at the same time *t+1*; and X_{it-1} is a vector of conditioning covariates observed at time *t-1*.

The implementation of the matching directly on the covariates, or covariate matching, might be impractical when the vector of conditioning covariates X is highly dimensional (Zhao 2008). To overcome the "curse of dimensionality", Rosenbaum and Rubin (1983) suggest matching on the propensity score, or the probability of assignment to a particular treatment conditional on a vector of relevant pre-treatment covariates.[8] Using propensity score, the equation for the average securitization effect becomes:

$$\tau = E(\Delta y^{1}_{it+1} \mid S_{it} = 1, p(X_{it-1})) - E(\Delta y^{0}_{it+1} \mid S_{it} = 0, p(X_{it-1})) \quad (4)$$

where p is a propensity score conditional on X_{it-1}. In other words, the average securitization effect is estimated as the difference between the mean performance change of the first-time securitizers after their first securitization and that of the banks that had ex-ante similar likelihood of securitizing but did not.

For consistent estimates of the securitization effect, two key assumptions must hold: the unconfoundedness assumption and the common support assumption. The

unconfoundedness assumption, also referred to as the "conditional independence assumption" or "selection on observables", requires the mean outcomes to be independent of the treatment after conditioning on a set of observable covariates (Imbens 2004, Smith and Todd 2005) and can be formally stated as:[9]

$$(\Delta y^{0}_{it+1}, \Delta y^{1}_{it+1}) \perp S_{it} \mid X_{it-1} \text{ or } (\Delta y^{0}_{it+1}, \Delta y^{1}_{it+1}) \perp S_{it} \mid p(X_{it-1}) \quad (5)$$

In other words, it assumes that there are no unobservable differences between first-time securitizers and non-securitizers after conditioning on X_{it-1}, so that any systematic differences in outcomes can be attributed to the securitization effect.

The unconfoundedness thus assumes away the potential bias arising from the selection on observables (Sianesi 2004).[10] To link the unconfoundedness assumption with standard exogeneity assumptions, it could be written as:

$$\Delta y_i = \alpha + \tau S_i + \beta X_i^{'} + \varepsilon_i \quad (6)$$

Here, the unconfoundedness is equivalent to the independence of S_i and ε_i conditional on X_i which would also capture the idea that S_i is exogenous (Imbens 2004). This is a strong assumption because, even after conditioning on the observable covariates included in X, there may be systematic differences between the first-time securitizers' and non-securitizers' outcomes (Smith and Todd 2005).[11] Such discrepancies may arise, for example, because first-time securitizers and non-securitizers may operate in regions that may have a differential impact on performance. Therefore, in this paper we estimate the securitization effect on the change in the performance of banks measured as the difference in outcomes before and after securitization. This is known as a difference-in-differences or double-difference matching strategy, where the first difference removes the unobserved heterogeneity and restores conditional independence and the second difference produces the impact estimate (Essama-Nssah 2006).[12] The assumptions required to justify the difference-in-differences matching estimator are weaker than those

required to justify simple matching; moreover, the difference-in-differences matching estimator is suggested to be the most robust (Heckman et al. 1998, Smith and Todd 2005).

Next, the common support, or overlap assumption requires an overlap in the distribution of covariates between the treated and control units to make matching possible (Imbens 2004) and can be formally stated as:

$$0 < \Pr(S_{it} = 1 \mid X_{it-1}) < 1 \tag{7}$$

This assumption imposes a positive probability of either securitizing ($S_{it} = 1$) or not securitizing ($S_{it} = 0$), to ensure the existence of potential matches for each first-time securitizer among non-securitizers.[13]

When the unconfoundedness and common support assumptions are satisfied, the mean outcome observed for the matched non-treated group can be substituted for the missing counterfactual mean for the treated units (Smith and Todd 2005). In other words, if the two assumptions hold, we can estimate the casual effect of securitization using the mean outcome for the matched non-securitizers as a proxy for the performance change that the first-time securitizers would have had had they not securitized, that is, $E(\Delta y^{0}_{it+1} \mid S_{it} = 1)$ in equation (1).

This matching approach thus provides a means of dealing with the selection problem and a means of estimating causal treatment effects in a non-experimental context using observational data. The most attractive feature of the matching approach is its non-parametric nature, that is, it does not impose functional form restrictions in estimating the conditional expectation of the outcome variable and it leaves the individual causal effect unrestricted and hence allows arbitrary heterogeneity of the effects in the sample (Lechner 2002, Smith and Todd 2005, Zhao 2008).

4 DATA AND PRELIMINARY UNIVARIATE ANALYSIS

The data for this paper were obtained from the Federal Reserve's Reports of Condition and Income (Call Reports) that are filed by insured commercial banks on a quarterly basis and contain the complete balance sheet, income statement, and detailed supporting schedules, including a schedule of off-balance-sheet items. Starting from June 2001, US banks were required to provide detailed information on securitization activities in their regulatory forms.[14] Given the incorporation of the new data into the reporting forms, we use Call Reports from the second quarter of 2001 to the fourth quarter of 2008. When constructing the data set, we first exclude banks with missing information on total assets, liquidity, loans, deposits, capital, income, and securitization activities for any quarter of the sample period. We then keep banks with at least 5 consecutive quarters of data and define a bank as a securitizer if there is an outstanding securitization in at least one quarter. To prevent the possibility of outliers driving the results, we winsorize all quarterly ratio variables at the 1% level.[15] Finally, we average the quarterly data on a yearly basis to build a data set of annual observations.[16]

As a preliminary step to the PSM analysis, we begin with a cross-sectional analysis of the full sample and compare the characteristics of banks that securitize with those that do not. First-time securitizers are included in the group of securitizers because we analyze the differences between banks that never securitize and those that securitize at least once throughout the sample period.[17] The results of the comparisons are reported in Table 1. There are 9,182 banks in the sample, of which 432 are securitizers and 8,750 are non-securitizers. Despite their smaller number (4.7% of the sample), securitizers still account for nearly 67% of the sample by total assets.[18]

<Insert Table 1 about here>

Panel A of Table 1 presents a summary of the balance sheet information of the banks in our sample. We find that the most significant difference is bank size, with the mean value of total assets for securitizers ($15.6 billion) being approximately 40 times larger than that for non-securitizers ($0.4 billion). This finding is consistent with previous research that finds that larger banks are more likely to securitize (Minton, Sanders, and Strahan 2004, Uzun and Webb 2007, Bannier and Hänsel 2008, Jiangli and Pritsker 2008, Minton, Stulz, and Williamson 2009). Further, securitizers tend to hold less liquid assets (25% of total assets versus 27% for non-securitizers), which is consistent with them having better access to external funding and thus needing a smaller liquidity buffer compared to non-securitizers. While being relatively small, the trading asset ratio appears higher for securitizers. Both the loan ratio and the loan to deposit ratio are higher for securitizers (66% versus 64% for non-securitizers and 88% versus 79% for non-securitizers, respectively); this might reflect securitizers' reduced access to core deposits (which in turn might have forced them to securitize). It might also reflect their choice of funding because securitizing institutions are larger and might have a preference for accessing wholesale/interbank funds rather than relying on retail deposits.

Looking at the liability side of the balance sheet, we find that both securitizers and non-securitizers are mainly financed by deposits; however, securitizers rely on this source of funding to a smaller extent (76% of total assets versus 82% for non-securitizers). Further, 10.6% of total assets is funded by equity capital for securitizers compared with 11.4% for non-securitizers. This could reflect both the effect of securitization and/or a size effect where securitizers (which are on average larger banks) might tend to hold less capital. Interestingly, the data show that loan growth is lower for securitizers compared with non-securitizers (12% versus 15%); however, there appears to be no statistically significant difference between securitizers and non-securitizers in terms of asset growth (around 12% in both samples).

Table 1 also contains information on banks' loan portfolios (Panel B). Securitizers' loan portfolios differ in terms of both diversification and composition. In particular, they tend to be less diversified, as indicated by the mean value of the Herfindahl-Hirschman Index (HHI) of 0.59 versus 0.56 for non-securitizers, with real estate loans constituting more than 60% of total loans in both samples. Despite the similar relative distribution, there are differences in terms of the loan share values between securitizers and non-securitizers. Specifically, securitizers tend to hold less agricultural loans (4% versus 7% for non-securitizers) and more consumer (11% versus 9% for non-securitizers) and other loans (3% versus 2% for non-securitizers) on the balance sheet; while securitizers appear to hold less real estate and commercial and industrial loans (64% versus 66% for non-securitizers and 15% versus 16% for non-securitizers, respectively), the differences are not statistically significant.[19]

Comparing the regulatory capital (Table 1, Panel C), we find that securitizers have significantly less capital than non-securitizers on a risk-adjusted basis; nonetheless, they are overcapitalized in terms of regulatory requirements. For example, the mean total risk-based capital ratio for securitizers is 15% (compared with 18% for non-securitizers). Securitizers also have lower Tier 1 leverage and Tier 1 risk-based capital ratios (10% versus 11% for non-securitizers and 14% versus 17% for non-securitizers, respectively). This finding is consistent with Cebenoyan and Strahan (2004) who find that banks that sell loans hold less capital. Similarly, Minton, Stulz and Williamson (2009) find evidence to suggest that risk-adjusted capital ratios are lower for the net buyers of credit protection.

We next compare the risk profiles of securitizers and non-securitizers using a number of risk measures (Table 1, Panel D): (i) risk-weighted assets to total assets ratio; (ii) non-performing loan ratio; (iii) charge-off ratio; (iv) allowance ratio; (v) provision ratio; and (vi) time deposit premium. The latter measured as the interest rate spread between uninsured large time deposits (>=$100,000) and insured small time deposits (<$100,000) should be

greater for a riskier bank because uninsured depositors would require a higher rate to deposit money with the bank (Jiangli and Pritsker 2008). We find that securitizers are more risky in all the measures considered with the differences being statistically significant. Similar results are found by Jiangli and Pritsker (2008) and Minton, Stulz and Williamson (2009) with provision, charge-off, and non-performing loan ratios higher for securitizers. Jiangli and Pritsker suggest that this could reflect securitization and/or size effects in allowing banks to extend loans with higher expected losses.

For the cost of funding (Table 1, Panel E), we consider the cost of (i) total liabilities, (ii) total deposits, (iii) small time deposits, and (iv) large time deposits. We find that the cost of total liabilities is higher for securitizers, while the difference in the cost of deposits appears insignificant; this suggests that securitizing banks rely more heavily on non-deposit funding and pay a higher cost for this source of funding.

We next turn to the indicators of operating performance (Table 1, Panel F). The data show that securitizers are more profitable in terms of both return on equity and return on assets (11% versus 9% for non-securitizers and 1% versus 0.8% for non-securitizers, respectively). The net interest margin is, however, found to be lower for securitizers (3.6% versus 3.8% for non-securitizers); this suggests that the higher profitability of securitizers derives from non-interest income. The latter also constitutes a greater part of net operating revenue for securitizers (25% compared with 16% for non-securitizers), which is consistent with securitizers having an additional source of income in the form of servicing fees and possibly more revenue from trading activities.[20]

Finally, in panels G and H respectively of Table 1, we consider the structure of interest income and interest expense. We find that securitizers have less income from balances due from depository institutions and from federal funds sold and securities purchased under agreements to resell (REPO) (0.7% versus 0.8% for non-securitizers and 1.5% versus 2.3% for non-securitizers, accordingly), while more other interest income

(0.6% versus 0.4% for non-securitizers). As for the interest expense, we find that securitizers have significantly lower expense on deposits (81% versus 90% for non-securitizers); this is probably driven by the lower deposit ratio given that the data show no significant difference in the cost of deposits between securitizers and non-securitizers. Further, securitizers have greater expense associated with funding raised in the form of federal funds and securities sold under agreements to repurchase (REPO) (4.4% versus 1.8% for non-securitizers), trading liabilities and other borrowed money (13.7% versus 7.5% for non-securitizers), and subordinated notes and debentures (0.7% versus 0.1% for non-securitizers). Overall, the data show more significant differences between securitizers and non-securitizers in terms of the structure of interest expense rather than interest income.

Taken together, the comparisons suggest that securitizers appear to be more profitable, although they extend riskier loans while paying a higher cost of funds for the excessive risk taking. Securitizing banks also hold less liquidity, larger and less diversified loan portfolios, and less equity capital. They also diversify their funding to a greater extent through repurchase agreements, trading liabilities, and subordinated debt, and increase their non-interest income through fees and trading revenues.

5 PROPENSITY SCORE MATCHING ANALYSIS

5.1 First-Time Securitizers and Non-Securitizers

To determine the impact of securitization on bank performance, we focus on two groups of banks: first-time securitizers and non-securitizers. Given that securitization is a recurring activity, we focus on the first observed transaction to build the sub-sample of first-time securitizers from the sample of securitizing banks.[21] We do not use the first-time securitizers of 2001 and 2008 because for these cases we are not able to collect pre- and post-securitization information. Therefore, the treatment group for the propensity score

matching analysis consists of banks that conduct their first securitization in any year from 2002 to 2007. The control group is built from banks that do not securitize over the 2001-2008 period, that is, the sample of non-securitizers used in the univariate analysis in section 4. This gives 197 first-time securitizers and 46,375 bank-years in the control group of non-securitizers over the period from 2002 to 2007. Panel A of Table 2 reports the statistics on the final unmatched sample by year, which shows that the number of first-time securitizers in this unmatched sample is fairly evenly dispersed across the six years.[22]

<Insert Table 2 about here>

Table 3 reports the statistics for the 197 first securitizations in the unmatched sample by the type of underlying assets, that is: (i) mortgages; (ii) home equity lines; (iii) credit card receivables; (iv) auto loans; (v) other consumer loans; (vi) commercial and industrial loans; and (viii) all other loans, all leases, and all other assets. The statistics include the number of first securitizations and the amount of securitized assets relative to total assets for each asset type.

<Insert Table 3 about here>

The data show that of the 197 first securitizations, 135 transactions include mortgages, of which 8 combine mortgages with other assets and 127 include mortgages only. The next largest groups are: securitizations of all other loans, all leases, and all other assets (27 transactions), commercial and industrial loans (22 transactions), and credit card receivables (11 transactions). While most of the asset classes appear to be combined in a number of first securitizations, credit card receivables are not. This could be explained by the revolving nature of credit card receivables, which therefore entails a different securitization structure. The mean size of transactions varies from 1.5% of total assets for other consumer loan securitizations to around 7% of total assets for auto and commercial and industrial loan securitizations. Interestingly, the largest securitization transaction as a

proportion of total assets was comprised of commercial and industrial loans (47%) followed by one comprising of mortgages (42%).

5.2 Implementation of the Propensity Score Matching

The implementation of the propensity score matching approach can be broken down into three steps: (i) estimating propensity scores for first-time securitizers and non-securitizers; (ii) matching first-time securitizers with non-securitizers; and finally, (iii) estimating average securitization effects.

To estimate the propensity scores, we use a probit regression of a dummy variable that has a unit value for the first securitization, and zero otherwise.[23] According to the matching literature, the regressors included in the model should reflect both the institutional settings of banks and the theoretical and empirical background on the determinants of banks' decision to securitize. It is also worth noting that the main purpose of the propensity score estimation is not to predict the treatment, but to balance all the covariates between the two groups (Caliendo and Kopeinig 2008). To do so, we define six sets of bank-specific variables. The first set reflects general characteristics of bank balance sheet and income structure. From the asset side, we include measures of bank liquidity, loan portfolio size and composition. The latter is captured in terms of both the breakdown of loans into five major categories (real estate, commercial and industrial, agricultural, consumer, and other loans)[24] and the Herfindahl-Hirschman Index (HHI) calculated using the five loan shares. From the liability side, we include deposit and capital ratios. We also include bank size, measured as the logarithm of total assets.[25] Finally, we capture the income structure using the non-interest income to net operating revenue ratio.

Next we include sets of variables that proxy for most of the commonly cited motives for securitization: funding cost reduction; credit risk management; profitability

improvement; regulatory capital relief; and liquidity needs. The funding cost reduction hypothesis is captured by the cost of total liabilities. To reflect the credit risk management hypothesis, we use the non-performing loan ratio (Calomiris and Mason 2004, Jiangli and Pritsker 2008, Minton, Stulz, and Williamson 2009, Affinito and Tagliaferri 2010, Cardone-Riportella, Samaniego-Medina, and Trujillo-Ponce 2010). We capture bank profitability using return on equity (Minton, Sanders, and Strahan 2004, Bannier and Hänsel 2008, Minton, Stulz, and Williamson 2009). With respect to the regulatory capital relief hypothesis, we include the Tier 1 risk-based capital ratio (Calomiris and Mason 2004, Uzun and Webb 2007, Bannier and Hänsel 2008, Minton, Stulz, and Williamson 2009). Finally, we capture liquidity needs using the loan growth (Affinito and Tagliaferri 2010). We also indirectly capture other possible motives for securitization through the variables included in the balance sheet and income structure set. Specifically, the loan HHI captures the portfolio diversification motive; the non-interest income to net operating revenue ratio captures the banking activity diversification motive (Affinito and Tagliaferri 2010); and finally, bank size captures the possible influence of economies of scale (Uzun and Webb 2007, Bannier and Hänsel 2008, Jiangli and Pritsker 2008, Minton, Stulz, and Williamson 2009, Affinito and Tagliaferri 2010, Cardone-Riportella, Samaniego-Medina, and Trujillo-Ponce 2010, Panetta and Pozzolo 2010).

One of the required conditions in the propensity score matching analysis is that the variables included in the propensity score model should not be affected by the treatment (Caliendo and Kopeinig 2008). To this end, the bank-specific variables employed in our model are lagged by one year:

$$P(S_{it} = 1 \mid X_{it-1}, Z_{it-1}, St_i) \tag{8}$$

where S_{it} is a first-securitization dummy, X_{it-1} is a vector of general balance sheet characteristics, Z_{it-1} is a vector of variables capturing the five main hypotheses on the motivation for securitization, and St_i are state dummies.[26]

We estimate the propensity scores for the 197 first-time securitizers and 46,357 bank-years of non-securitizers reported in Panel A of Table 2, estimating the model year by year. For reporting reasons, we reproduce a pooled probit regression for the period from 2002 to 2007 as it yields qualitatively similar results. To control for dependence of standard errors for a given bank, we cluster the standard errors at the bank level. The estimates of the pooled regression are reported in Table 4.

<Insert Table 4 about here>

The results provide significant evidence for the economies of scale, banking activity diversification, and liquidity needs hypotheses. Specifically, we find that a bank is more likely to securitize if it has a larger size, a higher share of non-interest income in the net operating revenue, and high liquidity needs reflected in a higher loan growth. These results are consistent with previous studies on banks' propensity to securitize.

Having estimated the propensity scores, we proceed to match first-time securitizers with non-securitizers. We employ nearest-neighbor matching where the unit chosen from the non-securitizers (that is, unit *j* from the control group) as a match for the first-time securitizer (that is, unit *i* from the treatment group) is the one closest in terms of the propensity score: [27]

$$| p_i - p_j | = \min_{k \in \{S=0\}} \{ | p_i - p_k | \} \quad (9)$$

To avoid the risk of bad matches entailed in this approach, we impose a 1% tolerance level on the maximum propensity score distance allowed, the so called caliper.[28] We run nearest-neighbor matching year by year to ensure that each first-time securitizer is matched with an observation from the non-securitizer group of the same year the first securitization occurs. The empirical setting requires us to restrict the initial unmatched sample of first-time securitizers and non-securitizers to those with data from one year before and to two years after the first-securitization year.[29] Further, we impose the common support, or overlap condition, discussed earlier, by prohibiting the perfect

predictability of first securitization given the observed covariates to ensure the existence of potential matches in the non-securitizers group.[30] This leaves us with 168 first-time securitizers and their 168 non-securitizing controls in the matched sample. This is the sample used for the estimation of the average securitization effects. Panel B of Table 2 reports the number of completed matches by year.

To verify the quality of matching, we plot the distribution of the propensity score for the first-time securitizers and non-securitizers before and after matching (Figure 2). In the unmatched sample the propensity score distribution of the non-securitizers is skewed to the left, whereas it is very close to that of the first-time securitizers in the matched sample. This result suggests that the matches are appropriate.

<Insert Figure 2 about here>

Further, since matching is conditioned on the propensity score rather than on all covariates, we check whether the matching procedure is able to balance the distribution of all the relevant variables in both the control and treatment groups (Caliendo and Kopeinig 2008). Rosenbaum and Rubin (1985) suggest a two-sample t-test for comparing the distributions of the covariates in the treated and matched control groups. To this end, we compare the first-time securitizers and non-securitizers before and after matching and check if there remain any significant differences in the balancing covariates after conditioning on the propensity score. The results of the tests are reported in Table 5. We find significant differences before matching, whereas in the matched sample the covariates are balanced in both groups suggesting successful matching.

<Insert Table 5 about here>

6 SECURITIZATION EFFECT ON BANK PERFORMANCE: RESULTS

6.1 Main Results

We now use the matched sample to estimate the effects of securitization on the following indicators of bank performance: (i) cost of funding (cost of total liabilities and total deposits); (ii) credit risk (non-performing loan and charge-off ratios); (iii) profitability (return on assets and equity); (iv) interest income and expense structure (interest income and interest expense HHIs); (v) liquidity (liquidity and loan to deposit ratios); (vi) loan portfolio (loan ratio and loan HHI); (vii) capital (equity and Tier 1 risk-based capital ratios); and finally, (viii) growth (loan and asset growth). To do so, we first pool the yearly matched first-time securitizers and non-securitizers. Second, we calculate the changes in the performance indicators over a two-year window around the first-securitization year (that is, $\Delta y_{it+1} = y_{it+1} - y_{it-1}$) for each indicator. Finally, we estimate the average securitization effects as differences in the mean changes in the performance indicators between the first-time securitizers and non-securitizers.

We run the analysis for the full 2002-2007 sample with 336 banks in total. The results are reported in Panel A of Table 6. The estimates of the average securitization effects are presented as "Δ" with statistical significance in parentheses, where the latter is calculated based on bootstrapped standard errors. The interpretation of the estimates is as follows. If Δ is different from zero, the change in the performance indicator over the time window for the first-time securitizers is different from that for the matched non-securitizers. For example, a positive Δ for profitability would suggest a larger rise, a smaller drop, or a rise versus a drop in the profitability for the first-time securitizers compared to the matched non-securitizers, which in turn would suggest a positive effect of securitization on profitability.

<Insert Table 6 about here>

In what follows, we discuss the key differences between the two samples. We find a larger drop in the cost of total liabilities and total deposits for first-time securitizers, which

suggests a positive impact of securitization on the cost of funding. As for credit risk, securitization seems to result in a smaller rise in the non-performing loan ratio but a higher rise in the charge-off ratio. While the data show a reduction in both return on equity and return on assets for both samples, the reduction is larger for first-time securitizers thus suggesting a negative impact of securitization on bank profitability, in the short term at least. Both samples exhibit an increase in interest income concentration; however, first-time securitizers experience a smaller rise compared with non-securitizers. Looking at the interest expense structure, while both samples experience a decrease in concentration, the drop is smaller for first-time securitizers.

Turning to indicators of bank liquidity, we find a larger drop in the liquidity ratio for the first-time securitizers; the result is reversed for the loan to deposit ratio with first-time securitizers exhibiting a smaller rise. While both samples exhibit an increase in loan portfolio size and concentration, first-time securitizers' portfolio size and concentration increase to a lesser extent than those for matched non-securitizers.

The analysis of the impact of accessing the securitization market on bank capital produces mixed results: while first-time securitizers experience a smaller fall in equity capital, their Tier 1 risk-based capital ratio falls more compared with non-securitizers. Finally, we estimate a larger drop in both loan and asset growth for first-time securitizers.

The results of the analysis highlight some differences between first-time securitizers and non-securitizers; however, it is important to emphasize that none of the estimates are statistically different from zero. In other words, overall the results suggest that the first-time securitizers would have had comparable performance in the one year after first securitizing had they not securitized.

6.2 Three-Year Window

To test whether securitization takes effect over a longer period, we analyze a three-year window. To do so, we calculate the changes in the performance indicators as $\Delta y_{it+2} = y_{it+2} - y_{it-1}$. As with the two-year window, we then estimate the average securitization effects as differences in the mean changes in the performance indicators between the first-time securitizers and non-securitizers. We have to exclude from our sample 40 banks that securitized for the first time in 2007 because the *t+2* data are not available for these banks. This leaves 128 first-time securitizers and their 128 non-securitizing controls for the estimation.

The results of the three-year window analysis are reported in Panel B of Table 6. While for some performance indicators the estimates of the average securitization effect differ slightly from the two-year window results in terms of the magnitude, overall the signs and statistical significance of the estimates remain unchanged. In other words, consistent with the two-year window results, we find no evidence of a significant effect on bank performance of securitization over the longer three-year period.

6.3 Robustness Tests: Alternative Performance Measures

To validate our main results, we consider alternative measures for the performance indicators examined in the main part of the analysis. Specifically, for the cost of funding we use the cost of small and large time deposits. As alternative measures of credit risk, we consider the provision ratio and the time deposit premium. For profitability, we use the net interest margin, cost to income and non-interest income to net operating revenue ratios. We also break down the interest income and expense into the main categories. We consider the loan portfolio in terms of five major types of loans. Finally, we use Tier 1 leverage and total risk-based capital ratios as alternatives measures of capital.

We estimate securitization effects on the alternative performance measures using both two- and three-year windows. The results are reported in Table 7. Overall, we find that the evidence is consistent with the main finding of no significant effect of securitization on bank performance, apart from that on the consumer loan ratio where we find a larger drop for first-time securitizers over the two-year window. This might be a consequence of accessing the securitization market. For the three-year window the result for the consumer loan ratio is similar, although, the estimate is not statistically significant.

<Insert Table 7 about here>

Overall, we find no evidence that securitizing for the first time had a significant impact on the performance of banks, that is, first-time securitizers would have had comparable performance had they not securitized. Referring to Figure 1, the evidence suggests the performance trajectories of first-time securitizers (that is, First-Time Securitizers A and First-Time Securitizers B) might change the trend marginally after first securitization at time *t*, but remain close to the hypothetical trajectories presented by the dotted lines.

The finding of no significant impact of securitization on bank performance may be driven by a number of factors that might mitigate potential benefits of securitization, including: (i) the quality of assets securitized and of those retained on the balance sheet, which in turn might be driven by regulatory capital arbitrage and earnings management motives (Dionne and Harchaoui 2003, Ambrose, LaCour-Little, and Sanders 2005, Karaoglu 2005, Dechow, Myers, and Shakespeare 2010); (ii) contractual and non-contractual credit enhancements, which might result in the originating bank retaining significant interests in the securitized asset pool (Niu and Richardson 2006, Landsman, Peasnell, and Shakespeare 2008, Casu and Sarkisyan 2012); and (iii) post-securitization lending behavior in terms of both risk taking and the volume of credit supply (Cebenoyan and Strahan 2004, Loutskina and Strahan 2009, Panetta and Pozzolo 2010, Purnanandam 2011).

7 CONCLUSIONS

In this paper, we conduct an analysis of the effect of accessing the securitization market on bank performance. The theoretical predictions are that securitizing banks should have better performance because securitization should enable them to lower the cost of funding, to improve credit risk and capital management, and to increase profitability, both via income and portfolio diversification. Using US commercial bank data from 2001 to 2008, our univariate analysis reveals that securitizing banks do tend to be more profitable institutions, with a more diversified funding structure, but with higher funding costs, and with higher credit risk exposure. They also tend to hold larger and less diversified loan portfolios, have less liquidity, hold less capital, and appear to have lower loan growth compared with non-securitizing banks.

In an effort to understand better the impact of securitization on bank performance, we attempt to determine what would have happened to securitizing banks had they not securitized their assets. In other words, we try to identify the counterfactual performance. We do this by using propensity score matching (PSM) which allows us to estimate the effect of securitization by comparing the performance of first-time securitizers with that of banks that had, ex-ante, a similar securitization likelihood but which chose not to securitize. Using PSM, we estimate the effects of securitization on a number of bank performance indicators, including: (i) cost of funding; (ii) credit risk; (iii) profitability; (iv) interest income and expense structure; (v) liquidity; (vi) loan portfolio; (vii) capital; and finally, (viii) growth.

We find no evidence that securitization had significant effects on the performance indicators considered; that is, the results suggest that one and two years after a bank's first securitization, it would have had comparable performance had it not securitized. In other words, we find that securitization does not seem to outperform significantly

alternative performance-enhancing techniques used by adequately matched non-securitizing banks.

The absence in our findings of a significant impact of securitization on banks' performance may be partially driven by the underwriting and credit management techniques employed by securitizing banks – when performed poorly, these may undermine the potential performance benefits of accessing the securitization market. Specifically, while securitization may allow banks to raise funds at a lower cost, non-performing underlying assets may impair the banks' access to the market and require higher credit risk enhancements, thereby considerably increasing the cost of this funding source. In addition, while securitization may allow banks to reduce credit risk exposure by transferring the unexpected portion of the default risk to credit-enhancers and outside investors, management's incentives to ensure the performance of the securitized pool – and, thereby, establish and maintain a bank's reputation in the market - may result in "cherry-picking" of assets when designing the securitization transaction and in providing implicit and/or explicit recourse to the structure. This might be particularly important when banks access the securitization market for the first time. As a consequence, in the short term, the potential benefits to banks in terms of reduced cost of funding and reduced credit risk might be outweighed by the implicit and explicit costs of structuring the transaction. In the longer term, there is evidence in the literature that securitization may also trigger lax origination and monitoring processes. This could eventually offset the potential credit risk reduction achieved through securitization. Finally, the additional capital released through securitization can be used by banks for expansion purposes or to retire existing debt, which in turn might increase profitability. However, poor underwriting and credit risk management practices might offset the potential positive effect on profitability. Additionally, the effect on profitability of securitization may be distorted by managers' discretion afforded under fair value accounting rules.

Our research contributes to the literature by assessing the effects of securitization on a wide range of bank performance indicators. Overall, the results seem to suggest that the securitization model used by banks undermined the potential benefits offered by the market and therefore raise important questions about the motives for banks' increasing securitization activities over the past decade. This behaviour was possibly allowed in part by the increased complexity of transactions along with a lack of transparency in the market which may have been exacerbated by lenient regulation and supervision. Our results therefore support the on-going debate about the need to improve the regulation and supervision of securitization activities to bring more standardization and transparency into the market, with the aim to ensure that potential risks do not outweigh potential benefits of banks' engagement in securitization. Taken together, these regulatory changes will hopefully encourage banks to undertake more responsible securitizations in the future and, simultaneously, give investors more information on risks inherent in securitization needed to revive the market.

Our study also highlights the need for further research into the inherent risks of the securitization process, including those that emanate from the structure of transactions, implicit recourse, regulatory arbitrage, and earnings management; as well as the potential for these risks to impact on bank performance. In addition, while our analysis provides valuable findings on the securitization behaviour of US banks, the impact of securitization might be heterogeneous across different countries due to existing differences in accounting standards and/or regulatory practices. Therefore, further research is also needed to assess the impact of securitization on the performance of EU and other non-US banks in the run up to the crisis. Such research could potentially contribute to the continuing regulatory debate and to the search for a consensus in accounting standards for securitization activities across international markets.

APPENDIX 1

Table A1 Variable Names and Construction

Variable	Definition	Construction (Call Report items)
Balance sheet structure		
Total assets	Total assets	RCFD2170
Size	Logarithm(total assets)	LN(RCFD2170)
Liquidity ratio	(Cash + securities)/total assets	(RCFD0081 + RCFD0071 + RCFD1754 + RCFD1773)/RCFD2170
Trading asset ratio	Trading assets/total assets	RCFD3545/RCFD2170
Loan ratio	Total loans/total assets	RCFD1400/RCFD2170
Loans/deposits	Total loans/total deposits	RCFD1400/RCFD2200
Deposit ratio	Total deposits/total assets	RCFD2200/RCFD2170
Capital ratio	Total equity capital/total assets	RCFD3210/RCFD2170
Loan growth	Loan growth rate	
Asset growth	Asset growth rate	
Loan portfolio		
Real estate loan ratio	Real estate loans/total loans	RCFD1410/RCFD1400
Commercial and industrial loan ratio	Commercial and industrial loans/total loans	RCFD1766/RCFD1400
Agricultural loan ratio	Agricultural loans/total loans	RCFD1590/RCFD1400
Consumer loan ratio	Consumer loans/total loans	RCFD1975/RCFD1400
Other loan ratio	Other loans/total loans	(RCFD1400 - RCFD1410 - RCFD1766 - RCFD1590 - RCFD1975)/RCFD1400
Loan HHI	Loan Herfindahl-Hirschman index	$(RCFD1410/RCFD1400)^2$ + $(RCFD1766/RCFD1400)^2$ + $(RCFD1590/RCFD1400)^2$ + $RCFD1975/RCFD1400)^2$ + $((RCFD1400 - RCFD1410 - RCFD1766 - RCFD1590 - RCFD1975)/RCFD1400)^2$
Regulatory capital		
Tier 1 leverage ratio	Tier 1 leverage ratio	RCFD7204
Tier 1 risk-based capital ratio	Tier 1 risk-based capital ratio	RCFD7206
Total risk-based capital ratio	Total risk-based capital ratio	RCFD7205
Risk measures		
RWATA ratio	Risk-weighted assets/total assets	RCFDA223/RCFD2170
NPL ratio	Non-performing loans/total loans	(RCFD1407 + RCFD1403)/RCFD1400
Charge-off ratio	Net charge-offs/total loans	RIAD4635/RCFD1400
Allowance ratio	Allowance for loan losses/total loans	RCFD3123/RCFD1400
Provision ratio	Provision for loan losses/total loans	RIAD4230/RCFD1400
Time deposit premium	Interest rate on large time deposits – interest rate on small time deposits	RIADA517/RCONA514 - RIADA518/RCONA529
Cost of funding		
Total liabilities	Total interest expense/total liabilities	RIAD4073/RCFD2948
Total deposits	Interest expense on total deposits/total deposits	(RIAD4508 + RIAD0093 + RIADA517 + RIADA518 + RIAD4172)/RCFD2200
Small time deposits	Interest expense on small time deposits/ small time deposits (<$100,000)	RIADA518/RCONA529
Large time deposits	Interest expense on large time deposits/ large time deposits (>=$100,000)	RIADA517/RCONA514

(*continued on next page)*

Note: Variables used in study. Commercial bank data items are taken from Federal Reserve's Reports of Condition and Income (Call Reports).

Table A1 Continued

Variable	Definition	Construction (Call Report items)
Operating performance		
Return on equity	Net income/total equity capital	RIAD4340/RCFD3210
Return on assets	Net income/total assets	RIAD4340/RCFD2170
Net interest margin	Net interest income/total assets	RIAD4074/RCFD2170
Cost/income	Total non-interest expense/net operating revenue	RIAD4093/(RIAD4074 + RIAD4079)
Revenue HHI	Revenue Herfindahl-Hirschman index	$(RIAD4074/(RIAD4074 + RIAD4079))^2$ + $(RIAD4079/(RIAD4074 + RIAD4079))^2$
Non-interest income/net operating revenue	Non-interest income/net operating revenue	RIAD4079/(RIAD4074 + RIAD4079)
Interest income		
Loans	Interest income on loans/total interest income	(RIAD4010 + RIAD4065)/RIAD4107
Depositary institutions	Interest income on balances due from depository institutions/total interest income	RIAD4115/RIAD4107
Securities	Interest and dividend income on securities/total interest income	(RIADB488 + RIADB489 + RIAD4060)/RIAD4107
Trading assets	Interest income from trading assets/total interest income	RIAD4069/RIAD4107
REPO	Interest income on federal funds sold and securities purchased under REPO/total interest income	RIAD4020/RIAD4107
Other	Other interest income/total interest income	RIAD4518/RIAD4107
Interest income HHI	Interest income Herfindahl-Hirschman index	$((RIAD4010 + RIAD4065)/RIAD4107)^2$ + $(RIAD4115/RIAD4107)^2$ + $((RIADB488 + RIADB489 + RIAD4060)/RIAD4107)^2$ + $(RIAD4069/RIAD4107)^2$ + $(RIAD4020/RIAD4107)^2$ + $(RIAD4518/RIAD4107)^2$
Interest Expense		
Deposits	Interest expense on deposits/total interest expense	(RIAD4508 + RIAD0093 + RIADA517 + RIADA518 + RIAD4172)/RIAD4073
REPO	Interest expense on federal funds purchased and securities sold under REPO/total interest expense	RIAD4180/RIAD4073
Trading liabilities & other borrowed money	Interest expense on trading liabilities and other borrowed money/total interest expense	RIAD4185/RIAD4073
Subordinated notes	Interest expense on subordinated notes and debentures/total interest expense	RIAD4200/RIAD4073
Interest expense HHI	Interest expense Herfindahl-Hirschman index	$((RIAD4508 + RIAD0093 + RIADA517 + RIADA518 + RIAD4172)/RIAD4073)^2$ + $(RIAD4180/RIAD4073)^2$ + $(RIAD4185/RIAD4073)^2$ + $(RIAD4200/RIAD4073)^2$

Note: Variables used in the analysis. Commercial bank data items are taken from Federal Reserve's Reports of Condition and Income (Call Reports).

APPENDIX 2

Table A2 Summary Statistics for All Sample Banks and Univariate Tests of Differences in Characteristics between Long-Time Securitizers and Non-Securitizers

Variable	All banks			Long-time securitizers			Non-securitizers			Difference in means		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Abs	%	p-value
Panel A: Balance sheet structure												
Total assets ($ billion)	1.036	0.109	17.729	33.172	1.984	120.426	0.378	0.106	2.030	32.793	8666%	0.000
Liquidity ratio	0.268	0.247	0.138	0.242	0.223	0.127	0.269	0.248	0.138	-0.027	-10%	0.006
Trading asset ratio	0.000	0.000	0.000	0.001	0.000	0.002	0.000	0.000	0.000	0.001		0.000
Loan ratio	0.642	0.664	0.143	0.647	0.669	0.148	0.642	0.664	0.143	0.005	1%	0.683
Loans/deposits	0.795	0.809	0.196	0.907	0.905	0.242	0.793	0.807	0.195	0.114	14%	0.000
Deposit ratio	0.817	0.837	0.080	0.728	0.753	0.125	0.819	0.838	0.078	-0.091	-11%	0.000
Capital ratio	0.114	0.101	0.043	0.107	0.093	0.044	0.114	0.101	0.043	-0.007	-6%	0.038
Loan growth	0.149	0.081	0.233	0.100	0.087	0.097	0.150	0.081	0.235	-0.050	-33%	0.000
Asset growth	0.123	0.075	0.158	0.099	0.085	0.085	0.124	0.074	0.159	-0.025	-20%	0.000
Panel B: Loan portfolio												
Real estate loan ratio	0.659	0.687	0.191	0.603	0.667	0.272	0.660	0.687	0.189	-0.057	-9%	0.006
Commercial and industrial loan ratio	0.155	0.138	0.098	0.145	0.123	0.112	0.156	0.138	0.098	-0.010	-7%	0.231
Agricultural loan ratio	0.070	0.008	0.121	0.021	0.001	0.056	0.071	0.008	0.121	-0.050	-70%	0.000
Consumer loan ratio	0.093	0.068	0.090	0.146	0.081	0.160	0.092	0.068	0.088	0.054	59%	0.000
Other loan ratio	0.015	0.006	0.027	0.037	0.016	0.049	0.015	0.006	0.027	0.022	149%	0.000
Loan HHI	0.560	0.543	0.171	0.604	0.579	0.208	0.559	0.542	0.170	0.045	8%	0.004
Panel C: Regulatory capital												
Tier 1 leverage ratio	0.111	0.096	0.046	0.097	0.084	0.042	0.111	0.096	0.046	-0.014	-13%	0.000
Tier 1 risk-based capital ratio	0.167	0.139	0.085	0.131	0.113	0.056	0.168	0.139	0.085	-0.037	-22%	0.000
Total risk-based capital ratio	0.179	0.150	0.084	0.148	0.128	0.054	0.179	0.151	0.085	-0.032	-18%	0.000
Panel D: Risk measures												
RWATA ratio	0.689	0.699	0.124	0.744	0.757	0.147	0.688	0.698	0.124	0.056	8%	0.000
NPL ratio	0.010	0.008	0.009	0.012	0.010	0.009	0.010	0.008	0.009	0.002	20%	0.005
Charge-off ratio	0.003	0.002	0.004	0.009	0.004	0.012	0.003	0.002	0.004	0.006	193%	0.000
Allowance ratio	0.014	0.013	0.006	0.017	0.013	0.010	0.014	0.013	0.006	0.003	21%	0.000
Provision ratio	0.005	0.003	0.005	0.010	0.005	0.013	0.005	0.003	0.005	0.005	111%	0.000
Time deposit premium	0.000	0.000	0.005	0.001	0.000	0.007	0.000	0.000	0.005	0.001	-1000%	0.057
Panel E: Cost of funding												
Total liabilities	0.025	0.025	0.006	0.025	0.025	0.006	0.025	0.025	0.006	0.000	1%	0.528
Total deposits	0.024	0.024	0.006	0.024	0.023	0.007	0.024	0.024	0.006	0.000	-2%	0.444
Small time deposits	0.037	0.037	0.006	0.036	0.038	0.010	0.037	0.037	0.006	-0.002	-4%	0.047
Large time deposits	0.037	0.037	0.006	0.037	0.037	0.007	0.037	0.037	0.006	0.000	0%	0.863
Panel F: Operating performance												
Return on equity	0.087	0.091	0.076	0.125	0.118	0.068	0.087	0.090	0.076	0.039	45%	0.000
Return on assets	0.008	0.009	0.009	0.012	0.010	0.008	0.008	0.009	0.009	0.004	49%	0.000
Net interest margin	0.038	0.037	0.007	0.037	0.034	0.010	0.038	0.037	0.007	-0.001	-2%	0.245
Cost/income	0.714	0.679	0.205	0.634	0.621	0.129	0.716	0.680	0.206	-0.081	-11%	0.000
Revenue HHI	0.755	0.756	0.097	0.659	0.646	0.108	0.757	0.757	0.096	-0.098	-13%	0.000
Non-interest income/ net operating revenue	0.161	0.146	0.095	0.300	0.265	0.169	0.158	0.145	0.091	0.143	90%	0.000
Panel G: Interest income												
Loans	0.792	0.820	0.129	0.790	0.820	0.145	0.792	0.820	0.129	-0.002	0%	0.861
Depositary institutions	0.008	0.002	0.017	0.006	0.001	0.012	0.008	0.002	0.017	-0.003	-32%	0.006
Securities	0.170	0.144	0.122	0.168	0.145	0.129	0.170	0.144	0.122	-0.002	-1%	0.860
Trading assets	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000		0.000
REPO	0.022	0.014	0.025	0.015	0.007	0.024	0.023	0.015	0.025	-0.007	-32%	0.000
Other	0.004	0.003	0.004	0.007	0.006	0.006	0.004	0.003	0.004	0.003	87%	0.000
Interest income HHI	0.699	0.705	0.126	0.705	0.699	0.130	0.699	0.705	0.126	0.006	1%	0.554
Panel H: Interest expense												
Deposits	0.902	0.939	0.112	0.768	0.772	0.165	0.904	0.940	0.109	-0.136	-15%	0.000
REPO	0.019	0.005	0.036	0.054	0.025	0.065	0.018	0.004	0.035	0.036	201%	0.000
Trading liabilities & other borrowed money	0.077	0.040	0.096	0.157	0.129	0.129	0.075	0.039	0.094	0.082	109%	0.000
Subordinated notes	0.001	0.000	0.006	0.013	0.000	0.019	0.001	0.000	0.005	0.012	1700%	0.000
Interest expense HHI	0.852	0.890	0.141	0.701	0.669	0.180	0.855	0.893	0.139	-0.154	-18%	0.000

Note: The table presents descriptive statistics for: (i) all sample banks (9183 banks); (ii) long-term-securitizers (179) (ever-securitizers excluding first-time securitizers); and (iii) non-securitizers (8929). Mean, Med, and SD stand for the cross-sectional mean, median, and standard deviation values of the individual bank time series averages, accordingly. The last three columns report the comparison analysis of bank-specific characteristics between long-time securitizers and non-securitizers. Difference in means is calculated as the difference between long-time securitizers' and non-securitizers' means, in absolute (Abs) and percentage (%) values, with the p-values of the tests on the equality of means reported in the last column.

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1 This misalignment stems from the fact that the incentive structure of securitization can create adverse selection and moral hazard problems. Pennacchi (1988), Gorton and Pennacchi (1995), Duffee and Zhou (2001), Morrison (2005), and Parlour and Plantin (2008) posit a negative link. In contrast to much of the literature, Allen and Carletti (2006) suggest that credit risk transfer can be beneficial because it improves risk sharing. More recently, Chiesa (2008) finds that, if used properly, CRT does not necessarily weaken monitoring incentives and expands financial intermediation.

2 Amongst other goals, the US's Dodd-Frank Act now imposes constraints on US bank securitization activity. Improvements in the disclosure of details about securitizations is also one of the main aims of recent Financial Accounting Standards Board (FASB) amendments (FAS 166 and 167). Similar goals are also being pursued by European regulators (ECB 2011).

3 Through the securitization channel, banks may also be able to diversify interest income and expense; increase liquidity; modify their loan portfolio in terms of both size and diversification; increase capital ratios; and use the capital released through securitization for expansion purposes (OCC 1997).

4 Source: Securities Industry and Financial Markets Association (SIFMA)

5 A comprehensive review of the literature on securitization can be found in Gorton and Metrick (2012). Tymoigne (2009a, b) provide a useful background on the securitization process.

6 These methodological issues are not unique to estimating the effect of securitization. For example, Barba Navaretti and Castellani (2008) discuss similar issues in estimating the impact of foreign investment.

7 In the context of securitization, a number of studies have applied the instrumental variables estimator, with bank size commonly used as an instrument for the securitization decision (e.g., Jiangli and Pritsker 2008). Other studies have attempted to control for the selection bias by applying the two-stage Heckman procedure (e.g., Panetta and Pozzolo 2010). However, potential issues are embedded in both approaches (for more detail, see Blundell and Dias 2000).

8 Both matching on covariates and matching on the propensity score will make the conditional distribution of covariates in the treatment and control groups the same (Zhao 2004). The argument for matching on the propensity score is that it allows conditioning on a scalar variable rather than in a general n-space, thereby substantially reducing the dimensionality of the matching problem (Dehejia and Wahba 2002).

9 Symbol $\perp$ stands for orthogonality between two variables.

10 Selection on observables is one of the three sources of bias identified by Heckman et al. (1998). The other two sources of bias are dealt with by the common support assumption discussed later in the section.

11 As a general rule, economic theory can help in choosing the conditioning covariates to be included in X on the basis of their role in the decision process (Imbens 2004). As noted by Smith and Todd (2005), the set of covariates that satisfies the matching conditions is not necessarily the most inclusive one. They suggest that augmenting a set that satisfies the identification conditions for matching could lead to a violation of those conditions; adding additional covariates may also intensify a common support problem. A number of papers find larger biases with cruder conditioning sets (Heckman et al. 1998, Lechner 2002).

12 This is a non-parametric version of the widely used difference-in-differences estimator.

13 By choosing and reweighting the observations in the region of common support, matching eliminates the other two of the three sources of bias identified by Heckman et al. (1998): the bias arising from the differences in the supports of X between the treated and control groups and the bias arising from the differences in the shapes of the distributions of X between the two groups in the common support region. Heckman et al. provide empirical evidence of the importance of imposing the common support condition in reducing bias and suggest that this constitutes the benefit of the non-parametric approach to econometrics.

14 FFIEC (2000): www.ffiec.gov/press/pr110200.htm

15 Winsorization consists of replacing the data below the N^{th} percentile with the N^{th}, that is, a 1% winsorization implies replacing the data below 1^{st} percentile with the 1^{st} percentile data.

16 Details on the construction of the variables are provided in Appendix 1.

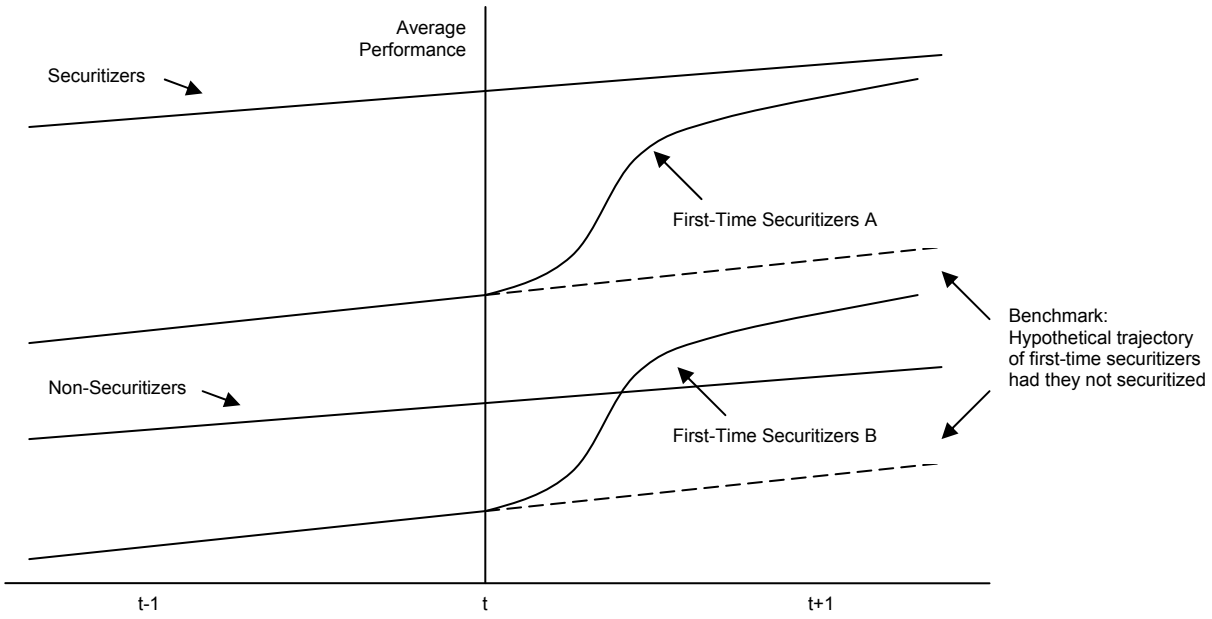
17 First-time securitizers might, on average, resemble non-securitizers more than would long-time securitizers. To check whether the cross-sectional analysis finds clearer distinctions, we also compare long-time securitizers (that is, excluding first-time securitizers from the sample of securitizing banks) and non-securitizers. The results are reported in Appendix 2.

18 Calculated as the sum of the cross-sectional mean total assets of securitizing banks over the sum of the cross-sectional mean total assets of all sample banks.

19 Minton, Stulz, and Williamson (2009) using US bank holding company data find similar evidence.

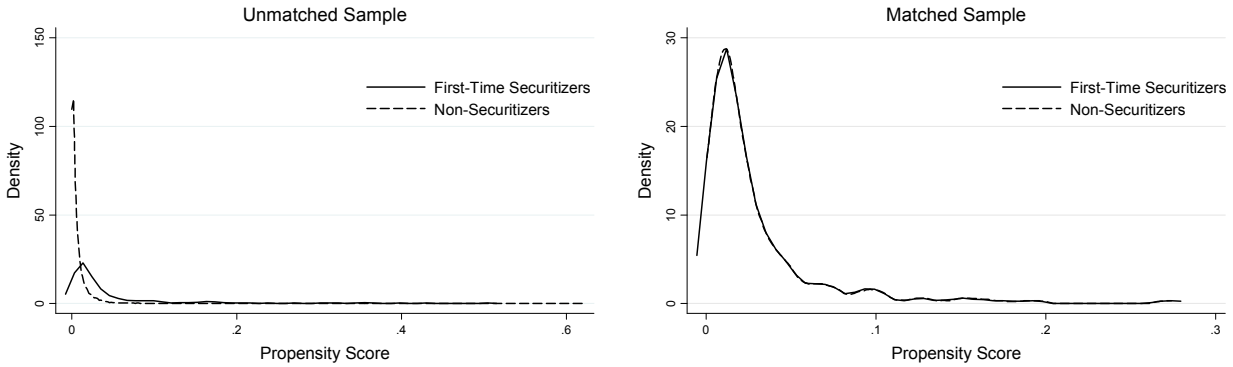
20 Minton, Stulz, and Williamson (2009) find that the net buyers of credit protection have dramatically more trading revenue than other banks.
21 That is, the first securitization during the lifetime of a bank in the sample.
22 For example, in year 2004, the 23 first-time securitizers are banks that do not securitize in 2001, 2002, 2003 and securitize in 2004; the 7,774 non-securitizers are banks that do not securitize throughout the whole sample period, that is, from 2001 to 2008.
23 Zhao (2008) provides evidence to suggest that, when the matching assumptions are satisfied, the choice of the estimator for the propensity score (probit, logit, or linear probability model) has little impact on the estimates of the average treatment effect. Caliendo and Kopeinig (2008) suggest that logit and probit models might be preferable to the linear probability model; as for the choice of logit or probit, it is not critical for the binary treatment case because in this case the models usually yield similar outcomes.
24 "Other loan ratio" is dropped from the probit model due to the multicollinearity.
25 A few studies show that large banks are more likely to securitize because of the economies of scale enjoyed in underwriting and securitization, or because of the diseconomies of scale in deposit funding (Bannier and Hänsel 2008, Jiangli and Pritsker 2008). Loutskina (2011) notes that only large banks have a sufficient number of loans to access the securitization market independently of other financial intermediaries.
26 We repeated this exercise using real gross state product and real gross state product per capita to test the robustness of our results to these alternative specifications. The results remain qualitatively consistent.
27 There is a range of matching estimators available (e.g., nearest-neighbor, radius, kernel). All of these compare the outcome of the treated units with the outcome of the control units to determine the average treatment effect, but they differ in the way the neighborhood is defined and in the way the weights for the neighbors are constructed (Smith and Todd 2005). The choice among matching methods is accompanied by a trade-off in terms of efficiency and bias - using a single control unit for each treatment unit (nearest-neighbor matching) ensures the smallest propensity score distance between the treatment and control units while using more control units (radius and kernel matching) increases the precision of the estimates, but at the cost of increased bias (Dehejia and Wahba 2002, Smith and Todd 2005). Dehejia and Wahba (2002) suggest that in general the choice of the estimator depends on the data in question; specifically, it depends on the degree of overlap between the treatment and control groups in terms of the propensity score. Having experimented with different versions, we find that the nearest-neighbor matching estimator performs best for our data.
28 Bad matches might occur if the closest neighbor is far away in terms of the propensity score. Applying a caliper implies that a unit from the control group chosen as a match for a treated unit lies within the caliper ("propensity range") and is closest in terms of the propensity score. In this case the matching quality rises; however, the variance of the estimates may increase if fewer matches can be performed as a result of excluding from the analysis the treated units with no matches found within the caliper (Smith and Todd 2005, Caliendo and Kopeinig 2008).
29 To be able to conduct the three-year window analysis (that is, from t-1 to t+2, with the first securitization at time t), we had to impose a two-year post-securitization data requirement. This requirement does not apply to the 2007 first-time securitizers, as these banks are only included in the two-year window analysis (that is, from t-1 to t+1) because they do not have the t+2 data.
30 The analysis is conducted using PSMATCH2 module for Stata developed by Sianesi and Leuven (2003).

Figure 1: Performance Trajectories



Note: The graph illustrates theoretical trajectories of average performance for: (i) securitizers, i.e., banks that have undertaken at least one securitization transaction at the beginning of the observation period (at time t-1); (ii) non-securitizers, i.e., banks that do not engage in securitization throughout the observation period (from t-1 to t+1); and (iii) first-time securitizers, i.e., banks that switch from being non-securitizers to being securitizers at time t by conducting their first securitization transaction. The first-time securitizers are presented by First-Time Securitizers A and First-Time Securitizers B, which are better and worse performers, respectively, compared to non-securitizers at time t-1.

Figure 2: Distribution of the Propensity Score of First-Time Securitizers and Non-Securitizers before and after Matching



Note: The graphs plot the propensity score distribution of the first-time securitizers and non-securitizers for the 2002-2007 period, before and after matching.

Table 1: Summary Statistics for All Sample Banks and Univariate Tests of Differences in Characteristics between Securitizers and Non-Securitizers

Variable	All banks			Securitizers			Non-securitizers			Difference in means		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Abs	%	p-value
Panel A: Balance sheet structure												
Total assets ($ billion)	1.095	0.110	17.591	15.614	0.458	79.287	0.378	0.106	2.030	15.235	4026%	0.000
Liquidity ratio	0.268	0.247	0.138	0.249	0.232	0.126	0.269	0.248	0.138	-0.020	-8%	0.001
Trading asset ratio	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.001		0.000
Loan ratio	0.643	0.664	0.142	0.658	0.675	0.137	0.642	0.664	0.143	0.015	2%	0.025
Loans/deposits	0.797	0.811	0.196	0.881	0.884	0.213	0.793	0.807	0.195	0.088	11%	0.000
Deposit ratio	0.816	0.836	0.081	0.759	0.788	0.115	0.819	0.838	0.078	-0.060	-7%	0.000
Capital ratio	0.114	0.100	0.043	0.106	0.095	0.039	0.114	0.101	0.043	-0.008	-7%	0.000
Loan growth	0.149	0.082	0.232	0.122	0.097	0.138	0.150	0.081	0.235	-0.028	-19%	0.000
Asset growth	0.123	0.075	0.157	0.116	0.091	0.109	0.124	0.074	0.159	-0.008	-7%	0.139
Panel B: Loan portfolio												
Real estate loan ratio	0.659	0.687	0.191	0.643	0.689	0.238	0.660	0.687	0.189	-0.017	-3%	0.138
Commercial and industrial loan ratio	0.155	0.138	0.098	0.148	0.132	0.104	0.156	0.138	0.098	-0.007	-5%	0.146
Agricultural loan ratio	0.069	0.007	0.120	0.038	0.002	0.078	0.071	0.008	0.121	-0.033	-46%	0.000
Consumer loan ratio	0.093	0.068	0.091	0.112	0.069	0.131	0.092	0.068	0.088	0.020	22%	0.002
Other loan ratio	0.015	0.006	0.028	0.029	0.011	0.044	0.015	0.006	0.027	0.014	95%	0.000
Loan HHI	0.560	0.544	0.171	0.594	0.569	0.193	0.559	0.542	0.170	0.035	6%	0.000
Panel C: Regulatory capital												
Tier 1 leverage ratio	0.111	0.095	0.045	0.098	0.087	0.039	0.111	0.096	0.046	-0.013	-12%	0.000
Tier 1 risk-based capital ratio	0.167	0.138	0.084	0.136	0.117	0.056	0.168	0.139	0.085	-0.032	-19%	0.000
Total risk-based capital ratio	0.178	0.149	0.084	0.151	0.130	0.054	0.179	0.151	0.085	-0.029	-16%	0.000
Panel D: Risk measures												
RWATA ratio	0.690	0.699	0.124	0.726	0.734	0.132	0.688	0.698	0.124	0.038	5%	0.000
NPL ratio	0.010	0.008	0.009	0.011	0.009	0.009	0.010	0.008	0.009	0.001	7%	0.097
Charge-off ratio	0.003	0.002	0.004	0.005	0.003	0.009	0.003	0.002	0.004	0.002	83%	0.000
Allowance ratio	0.014	0.013	0.006	0.015	0.013	0.008	0.014	0.013	0.006	0.001	5%	0.088
Provision ratio	0.005	0.003	0.005	0.007	0.004	0.009	0.005	0.003	0.005	0.002	48%	0.000
Time deposit premium	0.000	0.000	0.005	0.001	0.000	0.006	0.000	0.000	0.005	0.001	600%	0.055
Panel E: Cost of funding												
Total liabilities	0.025	0.025	0.006	0.025	0.025	0.006	0.025	0.025	0.006	0.001	2%	0.048
Total deposits	0.024	0.024	0.006	0.024	0.024	0.006	0.024	0.024	0.006	0.000	-1%	0.686
Small time deposits	0.037	0.037	0.006	0.036	0.038	0.008	0.037	0.037	0.006	-0.001	-2%	0.116
Large time deposits	0.037	0.037	0.006	0.037	0.038	0.006	0.037	0.037	0.006	0.000	1%	0.479
Panel F: Operating performance												
Return on equity	0.088	0.091	0.076	0.107	0.106	0.070	0.087	0.090	0.076	0.021	24%	0.000
Return on assets	0.008	0.009	0.009	0.010	0.010	0.007	0.008	0.009	0.009	0.002	26%	0.000
Net interest margin	0.037	0.037	0.007	0.036	0.035	0.008	0.038	0.037	0.007	-0.001	-3%	0.001
Cost/income	0.714	0.678	0.204	0.667	0.647	0.151	0.716	0.680	0.206	-0.049	-7%	0.000
Revenue HHI	0.754	0.755	0.097	0.693	0.690	0.106	0.757	0.757	0.096	-0.065	-9%	0.000
Non-interest income/ net operating revenue	0.162	0.147	0.096	0.245	0.205	0.152	0.158	0.145	0.091	0.087	55%	0.000
Panel G: Interest income												
Loans	0.792	0.820	0.129	0.799	0.824	0.129	0.792	0.820	0.129	0.007	1%	0.292
Depositary institutions	0.008	0.002	0.017	0.007	0.001	0.014	0.008	0.002	0.017	-0.002	-19%	0.028
Securities	0.170	0.144	0.121	0.167	0.145	0.117	0.170	0.144	0.122	-0.003	-2%	0.581
Trading assets	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000		0.000
REPO	0.022	0.014	0.025	0.015	0.008	0.023	0.023	0.015	0.025	-0.007	-32%	0.000
Other	0.004	0.003	0.004	0.006	0.005	0.005	0.004	0.003	0.004	0.002	58%	0.000
Interest income HHI	0.700	0.705	0.126	0.707	0.706	0.126	0.699	0.705	0.126	0.008	1%	0.194
Panel H: Interest expense												
Deposits	0.900	0.937	0.114	0.805	0.839	0.157	0.904	0.940	0.109	-0.100	-11%	0.000
REPO	0.019	0.005	0.037	0.044	0.017	0.062	0.018	0.004	0.035	0.026	143%	0.000
Trading liabilities & other borrowed money	0.078	0.042	0.097	0.137	0.109	0.123	0.075	0.039	0.094	0.062	83%	0.000
Subordinated notes	0.001	0.000	0.006	0.007	0.000	0.015	0.001	0.000	0.005	0.007	929%	0.000
Interest expense HHI	0.849	0.888	0.142	0.738	0.740	0.171	0.855	0.893	0.139	-0.117	-14%	0.000

Note: The table presents descriptive statistics for: (i) all sample banks (9182 banks); (ii) securitizers (432) (including first-time securitizers); and (iii) non-securitizers (8750). Mean, Median, and SD stand for the cross-sectional mean, median, and standard deviation values of the individual bank time series averages, accordingly. The last three columns report the comparison analysis of bank-specific characteristics between securitizers and non-securitizers. Difference in means is calculated as the difference between securitizers' and non-securitizers' means, in absolute (Abs) and percentage (%) values, with the p-values of the tests on the equality of means reported in the last column.

Table 2: Statistics on the Number of First-Time Securitizers and Non-Securitizers

Year	Panel A: Unmatched sample			Panel B: Matched sample		
	First-time securitizers	Non-securitizers	Total	First-time securitizers	Non-securitizers	Total
2002	30	7987	8017	23	23	46
2003	40	7907	7947	36	36	72
2004	23	7774	7797	21	21	42
2005	36	7665	7701	25	25	50
2006	25	7575	7600	23	23	46
2007	43	7449	7492	40	40	80
Total	**197**	**46357**	**46554**	**168**	**168**	**336**

Note: The table reports the statistics on the number of first-time securitizers and non-securitizers. Panel A reports the statistics for the unmatched sample, i.e., first-time securitizers that conduct their first securitization in any year from 2002 to 2007 and their unmatched control group of non-securitizers. Panel B reports the statistics for the matched sample, i.e., first-time securitizers and their matches that have data for the pre- (i.e., t-1) and post-securitization (i.e., t+1 and t+2 for the 2002-2006 banks and t+1 for the 2007 banks) years and satisfy the common support condition.

Table 3: Statistics on the First Securitizations

	Mortgage	Home equity	Credit card	Auto	Other consumer	Commercial and industrial	All other
Panel A: Number of transactions							
Mortgage	135	0	0	1	2	3	2
Home equity	0	6	0	0	1	1	0
Credit card	0	0	11	0	0	0	0
Auto	1	0	0	3	0	0	0
Other consumer	2	1	0	0	6	0	0
Commercial and industrial	3	1	0	0	0	22	3
All other	2	0	0	0	0	3	27
Only	127	4	11	2	3	15	22
Panel B: Size of transactions (as of total assets)							
Mean	0.0485	0.0282	0.0344	0.0744	0.0146	0.0717	0.0376
SD	0.0871	0.0350	0.0986	0.1146	0.0181	0.1216	0.0466
Min	0.0000	0.0015	0.0001	0.0000	0.0001	0.0002	0.0002
Max	0.4230	0.0949	0.3300	0.2064	0.0470	0.4727	0.2331

The table reports the statistics on the 197 first securitizations in the unmatched sample from 2002 to 2007 by the type of underlying assets, i.e.: (i) mortgages; (ii) home equity lines; (iii) credit card receivables; (iv) auto loans; (v) other consumer loans; (vi) commercial and industrial loans; and (viii) all other loans, all leases, and all other assets. Panel A reports the number of first securitizations across the asset types where row "Only" shows the number of transactions that include the respective asset type only. Panel B reports the descriptive statistics on the size of first securitizations relative to total assets, including the mean, standard deviation, minimum, and maximum values.

Table 4: Determinants of Banks' Propensity to Securitize

Regressor	Coefficient	Standard error
Liquidity ratio$_{it-1}$	0.127	0.439
Loan ratio$_{it-1}$	0.526	0.420
Real estate loan ratio$_{it-1}$	-0.634**	0.325
Commercial and industrial loan ratio$_{it-1}$	-0.797*	0.466
Agricultural loan ratio$_{it-1}$	-0.189	0.470
Consumer loan ratio$_{it-1}$	-0.507	0.502
Loan HHI$_{it-1}$	0.051	0.293
Deposit ratio$_{it-1}$	-0.772**	0.340
Capital ratio$_{it-1}$	0.007	1.189
Size$_{it-1}$	0.152***	0.026
Non-interest income/net operating revenue$_{it-1}$	0.623**	0.255
Cost of total liabilities$_{it-1}$	5.802	5.051
NPL ratio$_{it-1}$	-4.102	2.949
Return on equity$_{it-1}$	-0.492	0.397
Tier 1 risk-based capital ratio$_{it-1}$	-0.356	0.651
Loan growth$_{it-1}$	0.383***	0.112
Constant	-2.887***	0.903
State dummies	Yes	
Year dummies	Yes	
Pseudo R^2	0.093	
Log likelihood	-1145.030	
Observations	44084	

Note: The table reports the probit regression estimates of banks' propensity to securitize assets. The dependent variable equals to one for first-time securitizers and zero for non-securitizers. All explanatory variables are lagged one year. Standard errors of estimated coefficients are clustered at the bank level. *, **, *** stand for statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5: T-Test for Equality of Means of Covariates before and after Matching

	Unmatched sample			Matched sample		
Variable	**First-time securitizers**	**Non-securitizers**	**Difference in means**	**First-time securitizers**	**Non-securitizers**	**Difference in means**
Liquidity ratio$_{it-1}$	0.256	0.284	-0.028***	0.256	0.250	0.006
Loan ratio$_{it-1}$	0.663	0.634	0.029***	0.665	0.669	-0.004
Real estate loan ratio$_{it-1}$	0.661	0.647	0.014	0.679	0.693	-0.014
Commercial and industrial loan ratio$_{it-1}$	0.152	0.154	-0.002	0.153	0.164	-0.011
Agricultural loan ratio$_{it-1}$	0.052	0.078	-0.026***	0.060	0.051	0.009
Consumer loan ratio$_{it-1}$	0.088	0.100	-0.012*	0.082	0.072	0.010
Loan HHI$_{it-1}$	0.587	0.542	0.045***	0.573	0.591	-0.018
Deposit ratio$_{it-1}$	0.785	0.828	-0.043***	0.806	0.810	-0.004
Capital ratio$_{it-1}$	0.107	0.109	-0.002	0.102	0.107	-0.005
Size$_{it-1}$	12.581	11.603	0.978***	12.416	12.425	-0.009
Non-interest income/net operating revenue$_{it-1}$	0.200	0.161	0.039***	0.189	0.183	0.006
Cost of total liabilities$_{it-1}$	0.024	0.023	0.001**	0.025	0.025	0.000
NPL ratio$_{it-1}$	0.008	0.010	-0.002**	0.007	0.008	-0.001
Return on equity$_{it-1}$	0.104	0.104	0.000	0.108	0.104	0.004
Tier 1 risk-based capital ratio$_{it-1}$	0.149	0.164	-0.015**	0.142	0.147	-0.005
Loan growth$_{it-1}$	0.189	0.122	0.067***	0.172	0.161	0.011
Observations	197	45477	45674	168	168	336

Note: The table reports the means of various bank-specific characteristics for the first-time securitizers and non-securitizers, before and after matching. The difference in means is calculated as the difference between first-time securitizers' and non-securitizers' means. *, **, *** stand for statistical significance at the 10%, 5%, and 1% levels, respectively. The last row shows the number of first-time securitizers, non-securitizers, and the total number of observations in each sample.

Table 6: The Effect of Securitization on Bank Performance

	Panel A: Two-year window			Panel B: Three-year window		
	First-time securitizers	Non-securitizers	Δ (t-stat)	First-time securitizers	Non-securitizers	Δ (t-stat)
Cost of funding						
Total liabilities	-0.0009	-0.0008	-0.0002	0.0013	0.0016	-0.0003
			(-0.09)			(-0.18)
Total deposits	-0.0008	-0.0007	-0.0001	0.0011	0.0015	-0.0003
			(-0.08)			(-0.19)
Credit risk						
NPL ratio	0.0030	0.0049	-0.0019	0.0006	0.0028	-0.0022
			(-1.27)			(-1.56)
Charge-off ratio	0.0008	0.0007	0.0001	-0.0005	0.0006	-0.0011
			(0.17)			(-1.57)
Profitability						
Return on equity	-0.0188	-0.0165	-0.0022	-0.0177	-0.0139	-0.0038
			(-0.27)			(-0.45)
Return on assets	-0.0014	-0.0012	-0.0002	-0.0011	-0.0011	0.0000
			(-0.21)			(0.02)
Interest income and expense structure						
Interest income HHI	0.0090	0.0171	-0.0082	0.0117	0.0167	-0.0049
			(-1.02)			(-0.41)
Interest expense HHI	-0.0126	-0.0231	0.0104	-0.0220	-0.0268	0.0048
			(1.03)			(0.35)
Liquidity						
Liquidity ratio	-0.0117	-0.0099	-0.0018	-0.0201	-0.0151	-0.0049
			(-0.26)			(-0.47)
Loans/deposits	0.0264	0.0363	-0.0098	0.0439	0.0449	-0.0011
			(-0.90)			(-0.07)
Loan portfolio						
Loan ratio	0.0142	0.0179	-0.0037	0.0217	0.0238	-0.0021
			(-0.49)			(-0.20)
Loan HHI	0.0123	0.0199	-0.0076	0.0208	0.0345	-0.0137
			(-1.14)			(-1.45)
Capital						
Capital ratio	-0.0002	-0.0025	0.0023	0.0027	-0.0009	0.0037
			(0.73)			(0.99)
Tier 1 risk-based capital ratio	-0.0098	-0.0076	-0.0022	-0.0100	-0.0049	-0.0050
			(-0.41)			(-0.83)
Growth						
Loan growth	-0.0772	-0.0678	-0.0093	-0.0645	-0.0492	-0.0153
			(-0.31)			(-0.47)
Asset growth	-0.0612	-0.0577	-0.0035	-0.0561	-0.0457	-0.0105
			(-0.15)			(-0.44)
Observations	168	168	336	128	128	256

Note: The table reports the propensity score matching estimates of the average treatment effect of securitization on performance of the first-time securitizers. The average treatment effect of securitization on a performance indicator (Δ) is estimated as the difference between the first-time securitizers' mean change in the performance indicator (column "First-time securitizers") and that of matched non-securitizers (column "Non-securitizers"), over a two-year window (Panel A) and a three-year window (Panel B). *T*-statistics based on bootstrapped standard errors are reported in parentheses. *, **, *** stand for statistical significance at the 10%, 5%, and 1% levels, respectively. The last row reports the number of first-time securitizers, non-securitizers, and the total number of observations for each estimation.

Table 7: Robustness Tests: Alternative Performance Measures

	Panel A: Two-year window			Panel B: Three-year window		
	First-time securitizers	Non-securitizers	Δ (t-stat)	First-time securitizers	Non-securitizers	Δ (t-stat)
Cost of funding						
Small time deposits	-0.0015	-0.0016	0.0001	0.0000	0.0004	-0.0003
			(0.07)			(-0.14)
Large time deposits	-0.0018	-0.0016	-0.0002	0.0016	0.0017	-0.0001
			(-0.13)			(-0.06)
Credit risk						
Provision ratio	0.0001	0.0005	-0.0004	-0.0011	0.0002	-0.0012
			(-0.56)			(-1.42)
Time deposit premium	-0.0005	0.0003	-0.0007	0.0014	0.0015	-0.0001
			(-0.81)			(-0.07)
Profitability						
Net interest margin	-0.0013	-0.0014	0.0000	-0.0021	-0.0015	-0.0006
			(0.03)			(-0.90)
Cost/income	0.0066	0.0064	0.0002	0.0069	0.0060	0.0008
			(0.01)			(0.05)
Non-interest income/net operating revenue	0.0034	-0.0088	0.0123	0.0018	-0.0081	0.0098
			(1.48)			(1.04)
Interest income structure						
Loans	0.0114	0.0120	-0.0006	0.0140	0.0132	0.0007
			(-0.08)			(0.08)
Depositary institutions	0.0001	-0.0003	0.0003	0.0003	0.0007	-0.0004
			(0.26)			(-0.28)
Securities	-0.0070	-0.0052	-0.0018	-0.0167	-0.0103	-0.0064
			(-0.27)			(-0.77)
Trading assets	0.00001	0.00002	-0.00001	0.00002	0.00001	0.00001
			(-0.49)			(0.47)
REPO	-0.0028	-0.0056	0.0028	0.0001	-0.0009	0.0010
			(1.32)			(0.37)
Other	-0.0004	0.0000	-0.0003	0.0003	-0.0005	0.0008
			(-0.53)			(1.04)
Interest expense structure						
Deposits	-0.0063	-0.0172	0.0108	-0.0104	-0.0170	0.0066
			(1.42)			(0.59)
REPO	0.0019	0.0037	-0.0018	0.0111	0.0097	0.0014
			(-0.45)			(0.27)
Trading liabilities & other borrowed money	0.0031	0.0120	-0.0089	-0.0017	0.0070	-0.0087
			(-1.19)			(-0.77)
Subordinated notes	0.0009	0.0005	0.0004	0.0006	0.0004	0.0002
			(0.67)			(0.27)
Loan portfolio						
Real estate loan ratio	0.0202	0.0203	-0.0001	0.0325	0.0321	0.0004
			(-0.01)			(0.05)
Commercial and industrial loan ratio	-0.0003	-0.0104	0.0101	-0.0033	-0.0153	0.0120
			(1.58)			(1.47)
Agricultural loan ratio	-0.0040	-0.0009	-0.0031	-0.0034	-0.0017	-0.0017
			(-1.25)			(-0.54)
Consumer loan ratio	-0.0143	-0.0081	-0.0062**	-0.0225	-0.0167	-0.0058
			(-1.97)			(-1.16)
Other loan ratio	0.0005	-0.0009	0.0014	-0.0009	-0.0011	0.0002
			(0.62)			(0.07)
Capital						
Tier 1 leverage ratio	-0.0026	-0.0042	0.0015	-0.0013	-0.0012	-0.0002
			(0.47)			(-0.04)
Total risk-based capital ratio	-0.0097	-0.0075	-0.0022	-0.0101	-0.0050	-0.0051
			(-0.45)			(-0.90)
Observations	168	168	336	128	128	256

Note: The table presents the robustness tests for the average treatment effect of securitization on performance of the first-time securitizers using alternative performance measures. The average treatment effect of securitization on a performance indicator (Δ) is estimated as the difference between the first-time securitizers' mean change in the performance indicator (column "First-time securitizers") and that of matched non-securitizers (column "Non-securitizers"), over a two-year window (Panel A) and a three-year window (Panel B). *T*-statistics based on bootstrapped standard errors are reported in parentheses. *, **, *** stand for statistical significance at the 10%, 5%, and 1% levels, respectively. The last row reports the number of first-time securitizers, non-securitizers, and the total number of observations for each estimation.